

## Activity: Oil Spill Cleanup



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### Summary

This hands-on experiment will provide students with an understanding of the issues that surround environmental cleanup. Students will create their own oil spill, try different methods for cleaning it up, and then discuss the merits of each method in terms of effectiveness (cleanliness) and cost. They will be asked to put themselves in the place of both an environmental engineer and an oil company owner who are responsible for the clean-up.

### Engineering Connection

#### Relating science concept to engineering

Environmental engineers are called upon to assist with the clean up of oil spills and other environmental hazards. They must be familiar with different methods of clean up and then effectively communicate these strategies with the community, the clean-up crew and the company/person behind the spill. Environmental engineers' contributions to environmental clean up are very important in keeping our Earth's water and land useable.

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**Grade Level:** 6 (5-7)

**Group Size:** 2

**Time Required:** 90 minutes

Activity Dependency :None

Expendable Cost Per Group : US\$ 2

**Keywords:** Exxon Valdez, oil spill, environmental engineering, cleanup, density, pollution, water,

solubility, oil, effects

Related Curriculum :

subject areas Earth and Space

curricular units Environmental Engineering

lessons Oil Spill

Educational Standards

- Colorado: Math
- c. Compute unit rates in real-world situations involving mixtures, concentrations, and distance-time relationships (Grade 6) [2009]
- c. Select and use appropriate units to accurately measure length, weight, capacity and time in problem-solving situations (Grade 6) [2009]
- Colorado: Science
- d. Research and critically evaluate data and information about the advantages and disadvantages of using fossil fuels and alternative energy sources (Grade 6) [2009]
- c. Identify problems, and propose solutions related to water quality, circulation, and distribution - both locally and worldwide (Grade 6) [2009]
- International Technology and Engineering Educators Association: Technology
- D. The management of waste produced by technological systems is an important societal issue. (Grades 6 - 8) [2000]
- E. Technologies can be used to repair damage caused by natural disasters and to break down waste from the use of various products and systems. (Grades 6 - 8) [2000]

Pre-Req Knowledge ([Return to Contents](#))

For the activity worksheet, students should be familiar with creating bar graphs.

Learning Objectives ([Return to Contents](#))

After this activity, students should be able to:

- Identify some causes and effects of oil spills on a water source and the organisms that use that water.
- Describe the different methods that environmental engineers use to clean up water pollution.
- Use volume to describe the amount of oil and water removed during the model clean up.
- Organize their oil removal data and analyze using a bar graph.

Materials List

Each group should have:

- 1 aluminum pie pan
- A large stone that fills about 20% of the pie pan (students can bring this in from home during the 2 weeks leading up to class)
- 2 bird feathers from a hobby shop
- 1 plastic spoon for skimming oil from the pie pan
- 1 small graduated cylinder (about 20 ml) for placing spoonfuls of skimmed oil/water
- 1 small funnel for adding skimmed oil/water to test tubes
- 4 oil absorbing cloth pads for absorbing oil (obtained by cutting big sheet into squares or using cotton balls/squares)
- 1 small squeeze bottle of Dawn® (or any "grease fighting") dishwashing detergent labeled "Dispersant"
- 2 copies of the Oil Spill Worksheet

For groups to share:

- Pitchers/jugs of water
- Plastic squeeze bottle (about 100 ml) containing dark vegetable oil (can be died with food coloring)
- A surplus of paper towels
- 1 large garbage bag for clean up

#### Introduction/Motivation ([Return to Contents](#))

The Exxon Valdez oil spill was one of the largest oil spills ever. It took four summers to clean up the spill. Why is it so hard to clean up oil? Why does it take so long? One reason is because of its low density, which makes oil float on top of water. In addition, oil is *hydrophobic* (afraid of water) so it does not like to be in water, and it would rather stick to anything other than water; therefore, it will stick to animals, beaches or rocks before it will mix with water.

In some cases, people rely on the environment's ability to dilute pollutants. For example, exhaust from cars is very toxic, but we depend on the environment's ability to mix the exhaust with the air in the atmosphere. Although it is not the best method of dealing with pollution, diluting the exhaust in the air actually reduces its toxicity. We are not harmed (i.e., poisoned) by carbon monoxide while just walking alongside a car, but we would be if we sat in a closed garage with the car running. The ocean works in the same way as the atmosphere. Some wastes are unavoidably disposed of in the ocean. Runoff from cities — such as New York City — is filled with various types of pollution, and it all ends up in the ocean at some point. The ocean can dilute the runoff to a certain extent — creating no immediate threat to inhabitants. Because of its hydrophobic properties, however, oil will never easily dilute into the ocean, which makes it very hard and time-consuming to clean up spills.

Oil spills, like most environmental issues, become very political situations. Many questions are asked, and blame is given. Who is responsible for the pollution? Who should pay for the clean up? How much should they pay? How should the spill be cleaned up? These and other questions are often highly-debated issues. For example, most oil companies would argue that the least expensive clean-up option should be used; whereas environmentalist and people impacted by an oil spill want the method that works the best — no matter the cost. In the case of the Exxon Valdez oil spill, Exxon paid a tremendous amount of money for the initial clean up, although a lot of oil still remains in and around Prince William Sound. Although Exxon has already paid \$1.1 billion in punitive damages to many of the local people who were negatively affected by the spill, they are still being sued for more. Another example of how complicated environmental issues can become is that even 15 years after the spill occurred, lawyers are still debating how much money should be paid to the 32,000 fisherman that were out of work because of the Exxon Valdez oil spill.

Today, we are going to create a model of an oil spill. You are going to play the role of environmental engineers and use different technologies to clean oil from water. You will use booms and skimmers (used to contain the oil and avoid spreading); absorbents (used to soak up the oil and avoid spreading); and dispersants (chemicals used to break down the oil). You will collect data on oil removal and then look the clean-up methods used from the viewpoint of both the environmental engineer and the oil company owner. How do you think they will feel about the oil spill cleanup?

#### Procedure

##### Before the Activity

Collect all the necessary materials. In order to give students enough time to experiment with oil remediation methods, have materials for each team separated into bins or bags, ready to give out to teams.

##### With the Students

First class period:

1. Introduce environmental engineering to the students. Talk about the different tasks for which environmental engineers are responsible: biotechnology, water treatment, wastewater treatment, hazardous waste management, landfill construction, etc. Mention that today, we will focus on an environmental problem that involves environmental engineers.
2. Ask students if they have ever heard of any oil spills, such as the Exxon Valdez. Talk about the significance of the oil spill, how much oil was released and the impact it had on the environment. (Note: If possible, print Figure 1 and 2 to show students the effects of the oil spill on the surrounding beach/land).



Figure 1. An oil covered beach, resulting from the Exxon Valdez Oil Spill.

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Figure 2. An oil slick approaching land, resulting from the Exxon Valdez Oil Spill.

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3. Discuss both the environmental engineer and the oil company owner positions with regard to the cost of clean-up. When is clean really clean and when is expensive really expensive? (For this activity, owners will desire the most effective clean up for a reasonable cost while environmental engineers will desire the most effective cleanup regardless of cost.)
4. Ask the students to brainstorm different methods for cleaning up an oil spill. (Write their suggestions on the board, reminding them that all suggestions are good and worth sharing.) Have them discuss if the suggested methods are really good (effective) at cleaning up spills and how expensive they think each idea might be.
5. After they finish brainstorming, discuss the methods that they will be using today to clean up the oil spill: 1) skimming, because oil floats, 2) absorbing it onto pads that specifically absorb oil, and 3) adding a dispersant to break up the oil "slick" on the surface into little droplets.
6. Ask them to form a hypothesis regarding which method they believe will be the best for cleanup and why and write it down on their Oil Spill Worksheet.
7. Have students set up their oil spill pans. Have them place the pan on their table and put the stone in the middle of the pan. Add water to their pie pans until they are about  $\frac{1}{2}$  full. Tell students that the stone is the land and the water is the ocean. One of their objectives when they start to cleanup their oil spill is to keep the oil away from the land.
8. Have them place a small amount (about one tablespoon) of oil (some type of dark vegetable oil or vegetable oil with food coloring added) in the pie pan. What happens? Have them watch closely to see if the oil moves toward the land.
9. Have them place a feather in the oily water. After 30 seconds or so, they should remove the feather so they can observe what the oil has done to it. What impact can they conclude that oil has on birds?
10. Have them use the skimmer (spoon) to try and remove the oil, pouring into a graduated cylinder. (Note: demonstrate how to use the spoon to gently skim off the top layer of oil without removing spoonfuls of water). Ask them to determine approximately what % oil and what % water they removed? They should write the number down on their Oil Spill Worksheet. (Note: They should be able to get the number from the graduated cylinder since the oil and water will separate in the cylinder.)
11. Have them place a score (H = high, M = medium, L = low) on their Oil Spill Worksheet for the cost and effectiveness of skimming if they were either the environmental engineer or the oil company owner.
12. Next, have them use the absorbent cloth to absorb the oil. Ask them if they think the cloth is expensive? How well did it work?
13. On their worksheet, have them rate the cloth in terms of effectiveness (H, M, L) and cost (High cost, Medium cost, Low cost) if they were either the environmental engineer or the oil company owner?
14. Lastly, have them place 1 or 2 drops of "dispersant" into the pie pan and stir it around with their spoon. They will notice that the oil appears to break up into small droplets. Is this an effective means for clean up?
15. Have them take the feathers and see what effect the oil now has on them? The feathers should be fine (the dispersant worked!).
16. Have them rate the dispersant in terms of cost and effectiveness if they were either the environmental engineer or the oil company owner?
17. Have the students clean up. The water, vegetable oil, and dispersant from the pie pan and test tube can be washed down the drain; place pie pans in garbage bags; clean their rocks with soap and water; clean up their surface areas with paper towels and return any reusable supplies to a common area.

Second class period:

1. Students will continue working on their worksheets. Ask the students to make two vertical bar

charts on their worksheet showing the relationship between low, medium, and high effectiveness (one of the bar charts) for each cleanup method and cost (the other bar chart) if they were an environmental engineer or an oil company owner. An example of each is shown in Figure 1.

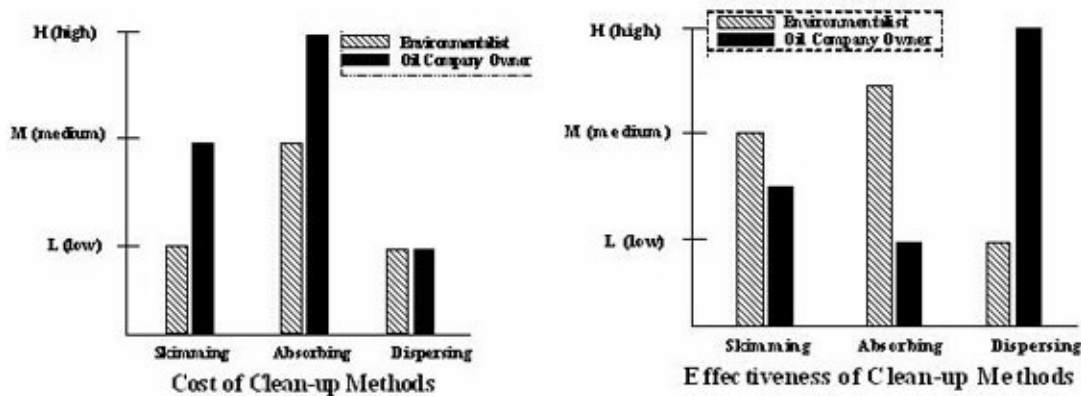


Figure 3. Sample bar charts.  
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- Have students discuss their answers with a partner. Let them know that they will need to be able to defend their answers.
- Take a Stand!:** Ask the students to take a stand on the following statements. They can line up in one of 5 rows based on if they agree *strongly*, *mildly*, *neutral* (don't know if they agree or not), *disagree mildly* or *disagree strongly* with the following statements. (Note: hang signs on the wall matching the possible responses, so students do not get confused as to which line they are in.) Randomly call on certain students to explain their stand.

- **Take a Stand!** "I think there was a high degree of effectiveness and low cost in cleaning up the oil spill using skimming." After they take a stand (i.e., form in their rows), discuss the impact of the ocean waves and how this would make skimming that much more difficult to carry out. Talk about how much water they picked up with their spoons and how effective this method really was. Talk about the cost of boats that perform skimming procedures.
- **Take a Stand!** "I think there was a high degree of effectiveness and low cost in cleaning up the oil spill using absorber cloth." The cloth should work well, but discuss with them the environmental impact of cleaning up or disposing of the cloth. Have they only added to the cleanup? This method may work nice in the pie pan, but how effective would this method be in an enormous ocean oil spill? Also, is this cloth expensive to buy?
- **Take a Stand!** "I think there was a high degree of effectiveness and low cost in cleaning up the oil spill using dispersants." Important: Ask them where the oil went. Ask them if the water is really clean or not so clean? Discuss with them the issues of putting more chemicals in the water and if this is appropriate or not. Discuss with them the fact that the ocean waves might mix the dispersant. How might the dispersant affect animals and organisms in the water?

- Collect the completed worksheets. Then, summarize the experiment. Be sure to talk about the perspectives that were presented, based upon if they were the environmental engineer or the oil company owner. Reflect on the bar charts as one possible scenario, but explain that different people would have different answers.

Attachments ([Return to Contents](#))

- [Oil Spill Worksheet](#)

Troubleshooting Tips

This activity can be very messy. Make sure there are plenty of paper towels for clean up! All materials in this activity can be disposed of in the garbage or down the drain.

Assessment ([Return to Contents](#))

#### Pre-Activity Assessment

*Brainstorming:* Ask the students to brainstorm different methods for cleaning up an oil spill. (Write their suggestions on the board, reminding them that all suggestions are good and worth sharing.) Have them discuss if the suggested methods are really good (effective) at cleaning up spills and how expensive they think each idea might be.

#### Activity Embedded Assessment

*Worksheet:* Have the students complete the Oil Spill Worksheet; review their answers to gauge their mastery of the subject. Verify that the students are using the different materials to collect their "oil spill" by walking around the classroom and asking the students which part of the procedure they are working on.

#### Post-Activity Assessment

*Prediction Analysis:* Have students compare their initial predictions with their test results, as recorded on the Oil Spill Worksheets. Ask the students to explain how effective the different methods were.

*Problem Solving:* Have the students engage in open discussion to suggest solutions to the following problem:

- After trying to contain, clean, dissolve, or remove the oil spill with the various utensils and "chemicals," you never reached a pristine environment. As environmental engineers, how would you approach the clean up of a major or minor oil spill in a local water resource? Which, if any, of the clean up technologies would you use? Would you use more than one?

*Persuasion Paper/Oral Defense:* Have students explain the jobs environmental engineers perform, sources of pollution, and why pollution is bad for the environment in a short paper or oral defense.

Activity Extensions ([Return to Contents](#))

**Cleaning Oiled Feathers Experiment** - In this experiment, students will look at the way oil affects bird feathers and try out different cleanup methods to find out which works best.

<http://response.restoration.noaa.gov/training-and-education/education-students-and-teachers/find-best-way-clean-oil-bird-f>

**Graphing Changes in Marine Life Abundance Activity** - This study uses the same methods used by real marine biologists. <http://oceanservice.noaa.gov/education/stories/oilymess/working.html>.

Have students research major oil spills in history at: [Bad Link](#)

<http://response.restoration.noaa.gov/faqs/history.html>

#### Activity Scaling

For 6th graders, focus on the bar graphs. Have the students present their graphs. If time permits, have them add pictures for support.

For 7th graders, do the activity as is.

For 8th graders, extra math support can be added by having students create a graph that compares the effectiveness (y-axis) versus clean up method (x-axis). They could create another graph that compares effectiveness versus costs of clean up different methods. Have them explain/support their answers with a persuasive paragraph. Or, have student groups develop an action plan for an area of the coast where an oil tanker has had a major spill. What should the community do? ...the local government? ... local engineers? Have the students use their graphs to support a proposal made by the local government to the community.

References ([Return to Contents](#))

"Exxon plans quick appeal in Valdez case," Colombia Daily Tribune,  
<http://www.showmenews.com/2004/Jan/20040129Busi006.asp>. Accessed January 29, 2004

Exxon Valdez Oil Spill Trustee Council [www.evostc.state.ak.us](http://www.evostc.state.ak.us)

Office of Response and Restoration, National Ocean Service, National Oceanic and Atmospheric Administration <http://response.restoration.noaa.gov/faqs/history.html>

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Supporting Program ([Return to Contents](#))

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